Computer modelling of phase change materials using the orthogonal collocation method

ABSTRACT

A computer program had been developed for aone-dimensional, orthogonal collocation model of a packed bed heat storage system. The system comprised of a cylindrical storage tank filled with phase change material (PCM) encapsulated in spherical containers. This paper also presented the thermal performance simulation of packed bed heat storage system using PCM during charging and discharging process. Paraffin wax was chosen as PCM, and air was chosen as heat transfer fluid (HTF).The enthalpy method was used in the model to accommodate the phase change behaviour of PCM over a range of temperature. It was shown that the governing equations were two energy conservation equations written for HTF and PCM. Both governing equations were numerically solved by applying orthogonal collocation approach implemented using MATLAB. The results obtained by solving the model using the orthogonal collocation method were initially validated with experimental results in the literature. The model covered through-flow conditions for charging and discharging the thermal heat storage within the air. In this paper, the complete computational model was simplified and efficient enough to interface with a larger program simulating a heat storage system. The simulations were conducted in order to derive the temperature profiles of HTF and PCM as well as to estimate the time required to complete charging and discharging of PCM.

Keyword: Phase change material; Orthogonal collocation; Modelling; Simulation